RESEARCH

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Asking a Better Question: Development and Evaluation of the Need For Trauma Intervention (NFTI) Metric as a Novel Indicator of Major Trauma

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ABSTRACT

Many existing metrics, such as Injury Severity Score (ISS), cannot fully describe many trauma patients because of comorbidities. This study developed and evaluated the Need For Trauma Intervention (NFTI) metric as a novel indicator of major trauma. The NFTI metric was developed from an analysis of 2,396 trauma patients at a Level I trauma center. Six commonly recorded registry variables were found to be indicative of major trauma and comprised the NFTI criteria: receiving packed red blood cells within 4 hr; discharge from the emergency department (ED) to the operating room within 90 min; discharge from the ED to interventional radiology; discharge from the ED to the intensive care unit (ICU) with an ICU length of stay (LOS) of 3 or more days; mechanical ventilation outside of procedural anesthesia within 3 days; or death within 60 hr. Patients meeting any NFTI criteria are classified as having major traumas and, therefore, needing trauma activations (NFTI+). Need For Trauma Intervention was tested in an overlapping sample of 9,737 patients. Being NFTI+ was associated with higher trauma activation levels, older age, higher ISS, worse ED vitals, longer hospital LOS, and mortality. Only 13 of 561 deaths were not NFTI+ and all were in patients with do not resuscitate (DNR) orders; using ISS greater than 15 missed 73 mortalities, 46 with DNR orders. Results suggest that NFTI provides a comprehensive view of both anatomy and physiology in a manner that self-adjusts for age, frailty, and comorbidities as long as care teams adjust their treatments. Need For Trauma Intervention appears to be a unique, simple, and effective tool to retrospectively identify major trauma, regardless of ISS.

Key Words

Major trauma, Medical resource utilization, Trauma severity indices

A 60-year-old, obese, anticoagulated smoker falls from standing and strikes his head. Upon presentation to the emergency department (ED), his Glasgow Coma Scale (GCS) score is 10 and he requires intubation. Simultaneously, a healthy, 25-year-old triathlete ambulates into the ED after crashing her mountain bike with multiple rib fractures; a self-splinted, closed forearm fracture; and a moderate, contained liver laceration. What level of trauma team activation do these patients need?

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This study was presented at the Texas Surgical Society on October 1, 2016, in Dallas, Texas, and the Trauma Quality Improvement Program (TQIP) Annual Meeting on November 6, 2016, in Orlando, Florida.

All authors disclose no financial conflicts of interest. This study was unfunded.

Supplemental digital content is available for this article. Direct URL citation appears in the printed text and is provided in the HTML and PDF versions of this article on the journal's Web site (www.journaloftraumanursing.com).

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DOI: 10.1097/JTN.0000000000000283

Reviews of the appropriateness of trauma activation decisions, such as these, are based on whether the patient suffered major trauma. The definition of major trauma is typically based on anatomic injury severity with an Injury Severity Score (ISS) greater than 15 considered a major trauma that warrants the highest level of trauma team activation. In the introductory vignettes, the former is clearly in need of rapid, meaningful trauma interventions, whereas the latter is sitting patiently, albeit in pain, in the waiting room. However, under this paradigm, the 60-year-old would be classified as overtriaged if he received a full trauma team activation because he had an ISS of 9. Conversely, if the 25-year-old did not receive a full trauma team activation, she would be undertriaged because her ISS was 22. These hypothetical cases illustrate the flaw of relying solely on anatomic injury severity to express physiologic needs. Although ISS does work relatively well for the majority of cases (Bull, 1975; Bull, 1978; Dick & Baskett, 1999; Gabbe et al., 2005; Semmlow & Cone, 1976) and is the accepted standard in trauma, these patients exemplify two categories in which it does not: first are the patients who—due to age, comorbidities, or both—have minimal physiologic reserves and consequently have systems that start to fail after relatively less severe or otherwise minor injuries; the second group consists of healthy, young, active patients with systems that are far more robust to the pathophysiological insults of injury. As such, a Grade 3 injury in the first group poses more danger than an identical Grade 3 injury in the second group. Because there is more than just anatomic injury severity to consider when assessing the appropriateness of a trauma activation, these clinical presentations are not fully described by ISS. This is because ISS is only partially associated with resource consumption and outcomes (Baxt & Upenieks, 1990) and performs even worse in geriatric traumas (McMahon, Schwab, & Kauder, 1996). Likewise, physiologic indicators that work well in younger patients to signal major trauma are less reliable in geriatric trauma patients (Lehmann, Beekley, Casey, Salim, & Martin, 2009; Martin, Alkhoury, O'Connor, Kyriakides, & Bonadies, 2010). These points are especially troubling given increases in the number of elderly trauma patients in the United States and the country's aging population (Ortman, Velkoff, & Hogan, 2014; Rhee et al., 2014).

The American College of Surgeons, Committee on Trauma (ACS-COT) tacitly acknowledges the shortcomings of ISS-based triage assessments and recommends using the ISS cutoff of 15 with case review to make further over- and undertriage determinations, which are based on the absence or presence of major trauma, respectively (Rotondo, Cribari, & Smith, 2014). However, these case reviews are largely subjective and entirely unstandardized. As such, an injury that constitutes major trauma at one center might not at another. Therefore, if over- and undertriage rate comparisons between institutions are to be valid, a new and standardized definition of major trauma is needed.

PURPOSE

The objective of this study was to develop and evaluate the Need For Trauma Intervention (NFTI) metric as a novel indicator of major trauma that can be used independently or to standardize the case review process.

METHODS

Metric Creation

Based on the premise that the need for rapid interventions and high levels of care might more reliably characterize patients than would anatomic or physiologic indicators, it was decided that the optimal approach was to create a metric on the basis of acute phase resource utilization and survival. Thus, by measuring resource consumption, NFTI would self-adjust for a patient's overall clinical condition—provided that care teams adjusted their treatments to account for age, frailty, comorbidities, and physiology. In addition, by measuring survival in the early phases of hospitalization, the metric should also be able to detect mortalities that are likely attributable to the trauma—but not later complications that are likely less relevant to trauma team activation—and do so even if care teams fail to adjust their treatments. Furthermore, to ensure that NFTI had clearly defined cutoffs, a binary (i.e., yes/no) metric was considered optimal.

With these goals in mind and under an institutional review board–approved protocol for retrospective database review, the prospectively maintained registry of a large, urban, ACS-verified Level I trauma center in Texas was used to query data for all patients receiving a full or partial trauma activation between July 1, 2014, and January 12, 2016 (n = 2,396). Existing registry variables thought to be associated with the need for full trauma activation were initially selected a priori. The rates of the resulting NFTI metric were compared against activation criteria and mechanism of injury in this sample. The NFTI criteria were then adjusted over several iterations until the resulting NFTI rates were congruent with clinical judgment and experience.

The final NFTI criteria are:

- receiving packed red blood cells (PRBC) within the first 4 hr of arrival;
- being discharged from the ED to the operating room (OR) within 90 min of arrival;
- being discharged from the ED to interventional radiology (IR);
- being discharged from the ED to the intensive care unit (ICU) and having a total ICU length of stay (LOS) of 3 or more calendar days;
- receiving mechanical ventilation for reasons other than procedural anesthesia within the first 3 days; and/or
- death within 60 hr of hospital arrival.

Patients meeting any one criterion or any combination of the criteria are classified as NFTI positive (NFTI+) and are deemed highly likely to have needed trauma activations regardless of ISS (i.e., suffered major trauma). Patients meeting none of these criteria are labeled as NFTI negative (NFTI−) and are considered highly unlikely to have needed trauma activations (i.e., not suffered major trauma).

Statistical Analyses

Statistical analyses of the finalized NFTI criteria were performed in an overlapping sample of all new trauma patients presenting to the ED of the aforementioned hospital between January 1, 2013, and August 21, 2016, and who met local trauma registry inclusion criteria (n = 9,738). These dates were selected because of a Trauma Quality Improvement Program (TQIP) registry field that was added in 2013 to indicate whether a patient received PRBC within 4 hr. One patient had missing variables that prevented NFTI from being assessed and was removed from analyses. This resulted in a final sample size of 9,737.

Data management and variable calculations were performed using TraumaBase (version 9, Clinical Data Management, Inc., Conifer, CO). All statistical analyses were performed using SPSS (release 19.0.0, IBM, Corp., Armonk, NY).

RESULTS

As shown in Table 1, there was a significant association between NFTI and tiered trauma response level ($\chi^2 =$ 2,671.87, $p < .001$). Full-team activations were NFTI+ 62.8% of the time; partial-team activations, 22.3%; trauma surgery consults, 7.9%; subspecialty surgical consults (e.g., orthopedic surgery without trauma surgery involvement), 6.3%; and nonsurgical patients, 1.0%. Of those who were NFTI+, the majority (60.6%) met only one criterion, most commonly the ICU criterion (Table 2).

To test NFTI's associations with multiple clinical variables, including demographics, anatomy, physiology, resource consumption, and outcome, a binary logistic regression was performed. This revealed that being NFTI+ was significantly associated with older age, higher activation levels, penetrating trauma, higher ISS, a faster initial ED pulse, lower initial ED mean arterial pressure (MAP), lower initial ED GCS score, longer total hospital LOS, and mortality (Table 3).

However, given that deaths within the first 60 hr of arrival are automatically captured by the NFTI metric and accounted for 71.8% (403/561) of all fatalities, the regression was rerun after excluding patients who died in the first 60 hr (Table 4). This revealed that NFTI was significantly associated with mortality after 60 hr as well. Only 13 of the 561 total deaths (2.3%) were classified NFTI−. All of the NFTI− deaths occurred in patients with do not resuscitate (DNR) orders and significant end-of-life care limitations, with a median (IQR) age of 81 (72–90) years, and who died after 7 (5.5–13.5) days. Comparatively, using only the ISS greater than 15 cutoff missed 73 total mortalities. In these 73 patients, 46 had DNR orders, median age was 72 (60–85) years, and the median LOS was 4 (1–8) days. After the first 60 hr, the ISS cutoff of greater than 15 missed 41 deaths, 36 of whom had DNR orders, with median age of 81 (67–88) years and median LOS of 8 (5.5–15) days. As shown by the fact that the 99% confidence intervals of the odds ratios on Table 5 do not overlap, NFTI was able to detect overall mortality and mortality after 60 hr better than was the ISS cutoff of greater than 15 at a significance level of $p < .01$. Using 99.9% confidence intervals, NFTI also outperformed ISS greater than 15 for overall mortality (69.815–446.225 vs. 19.594–45.604; $p < .001$) but not with mortality after 60 hr (17.942–121.562 vs. 6.977–23.339; $p > .001$). Also shown in Table 5 are the results of area under the curve (AUC) analyses. These revealed that NFTI had a larger AUC than ISS greater than 15 for mortality and mortality after 60 hr. Need For Trauma Intervention also had better sensitivity, but not specificity, for overall mortality and mortality after 60 hr.

DISCUSSION

Similar to the prehospital mantra of bringing the right patient to the right place at the right time, every trauma center aims to ensure that the right resources are available for the right patient at the right time. To this end, each institution establishes criteria for trauma team activation, generally in a tiered fashion, to preemptively mobilize resources on the basis of anticipated patient needs. Given that overtriage can waste resources and fatigue staff, and that undertriage can put patient care at risk, trauma centers are charged with honing these criteria to minimize over- and undertriage, with accepted rates of less than 5% undertriage and no more than 35% overtriage (Rotondo et al., 2014). The question is, how you define over- and undertriage?

Historically, the answer was that any patient with a major trauma, as indicated by an ISS greater than 15, who did not receive the highest level of trauma team activation

TABLE 1 NFTI Rates by Trauma Response Level

	NFTI+	NFTI−	Row Total
Full-team activation	1,419 (62.8%)	841 (37.2%)	2,260 (23.2%)
Partial-team activation	523 (22.3%)	1,825 (77.7%)	2,348 (24.1%)
Trauma surgery consult	311 (7.9%)	3,645 (92.1%)	3,956 (40.6%)
Subspecialty surgical consult	62 (6.3%)	916 (93.7%)	978 (10.0%)
Nonsurgical admission	2 (1.0%)	193 (99.0%)	195 (2.0%)
Column total	2,317 (23.8%)	7,420 (76.2%)	9,737 (100%)

Note. NFTI = Need For Trauma Intervention.

TABLE 2 Frequency (Percent) of Criteria Met for NFTI+ Patients

One criterion met	1,405 (60.6%)
PRBC only	69 (3.0%)
OR only	295 (12.7%)
IR only	10 (0.4%)
ICU only	580 (25.0%)
Ventilator only	258 (11.1%)
Death only	193 (8.3%)
Two criteria met	685 (29.6%)
PRBC, OR	123 (5.3%)
PRBC, IR	3 (0.1%)
PRBC, ICU	26 (1.1%)
PRBC, ventilator	25 (1.1%)
PRBC, death	30 (1.3%)
OR, ventilator	32 (1.4%)
ICU, ventilator	367 (15.8%)
ICU, death[a]	1 (0.0%)
Ventilator, death	78 (3.4%)
Three criteria met	201 (8.7%)
PRBC, ventilator, death	39 (1.7%)
PRBC, OR, death	24 (1.0%)
PRBC, OR, ventilator	54 (2.3%)
PRBC, IR, ventilator	3 (0.1%)
PRBC, ICU, ventilator	67 (2.9%)
ICU, ventilator, death[a]	14 (0.6%)
Four criteria met	25 (1.1%)
PRBC, OR, ventilator, death	18 (0.8%)
PRBC, IR, ventilator, death	2 (0.1%)
PRBC, ICU, ventilator, death[a]	5 (0.2%)
Five criteria met	1 (0.0%)
PRBC, OR, ICU, ventilator, death[a]	1 (0.0%)

Note. ICU = intensive care unit; IR = interventional radiology; OR = operating room; PRBC = packed red blood cells.
[a]Deaths occurred within 60 hr but three ICU days were accumulated because of postnoon ICU admissions that resulted in the ≤60-hr ICU stay spanning three calendar days.

available, was undertriaged, and that any patient with an ISS less than 15 but received the highest level of trauma team activation available was overtriaged. The initial—and only apparent—studies on this method (Cribari & Gujral, 2006; Cribari, Martin, Bonta, & Dean, 2006) showed that this was an effective way to classify patients as measured by hospital LOS and mortality. As stated in the background, although this method may be effective for most cases, there are many potential instances when it will not. Although there are myriad other metrics that outperform ISS (Champion et al., 1996; Osler, Baker, & Long, 1997; Rutledge, Osler, Emery, & Kromhout-Schiro, 1998), few are as easily calculated as ISS and fewer still have established cutoffs that allow for them to be used to quantify major trauma. Avoiding these last two issues while also being able to avoid the flaws of ISS was among the main goals of this project, hence, the simple, binary metric that is no more than a checklist of early resource consumption and outcome.

The NFTI metric is heterodoxical in that, unlike other clinical metrics, it does not directly measure any part of the patient's anatomy or physiology. Instead, NFTI incorporates the treatment of injury pathophysiology via a six-item checklist of care resource consumption and early mortality. By taking a more global view of the needs of the patient that focuses on neither anatomy nor physiology, NFTI appears to be able to provide a practical view of both. On measures of physiology, meeting NFTI criteria was associated with a faster pulse, lower MAP, and a lower GCS score. On measures of anatomy, being NFTI+ was associated with higher ISS and penetrating trauma. The NFTI+ rates were also associated with higher trauma activation levels. Finally, and perhaps most importantly, NFTI was associated with mortalities—both those captured by its death within 60-hr criterion and those occurring after the first 60 hr. This last point is particularly appealing given that, despite NFTI being a relatively conservative metric with fewer than 24% of patients being NFTI+, only 13 deaths in a 3.5-year period did not meet NFTI criteria—and perhaps appropriately so based on age, DNR status, and time from arrival to death.

Given that NFTI appears to be unique as a measure of early-stage resource consumption and outcome for trauma, there is, unfortunately, no real gold standard against which to compare it. Despite this, some credence may be appropriate given that NFTI largely overlaps with suggested non–ISS-based definitions of major trauma in *Resources for Optimal Care of the Injured Patient* (Rotondo et al., 2014, pp. 28 and 121). These suggestions included any trauma patient death, blood transfusion during initial resuscitation, intubation, hospital LOS greater than 2 days, ICU admission, intracranial pressure monitoring, any operative intervention, or catheter-based hemorrhage control.

By comparison, NFTI uses death within the first 60 hr rather than any death. In so doing, NFTI likely captures deaths directly related to injury that are more likely to be avoided with high-level interventions instead of deaths from later complications. Similarly, NFTI's use of nonprocedural mechanical ventilation within 3 days provides a reasonable cutoff to identify patients who likely needed

TABLE 3 Multivariable Associations With NFTI+[a]

	β (SE)	Wald χ^2 (*df*)	*p*	OR (99% CI)
Full-team activation (referent)		224.129 (4)		
Partial-team activation	−0.626 (0.093)	45.556 (1)	<.001	0.535 (0.421–0.679)
Trauma surgery consult	−1.471 (0.100)	214.450 (1)	<.001	0.230 (0.177–0.298)
Subspecialty surgical consult	−0.762 (0.160)	22.578 (1)	<.001	0.467 (0.309–0.706)
Nonsurgical admission	−4.737 (1.531)	9.576 (1)	.002	0.009 (<0.001–0.452)
Age	0.006 (0.002)	9.369 (1)	.002	1.006 (1.001–1.011)
Male gender	0.133 (0.082)	2.653 (1)	.103	1.143 (0.925–1.411)
Penetrating trauma	1.081 (0.100)	117.495 (1)	<.001	2.949 (2.281–3.813)
ISS	0.077 (0.005)	224.439 (1)	<.001	1.080 (1.066–1.094)
Pulse rate	0.007 (0.002)	13.030 (1)	<.001	1.007 (1.002–1.011)
MAP	−0.005 (0.002)	8.507 (1)	.004	0.995 (0.990–0.999)
GCS	−0.387 (0.020)	372.164 (1)	<.001	0.679 (0.645–0.715)
Total LOS	0.110 (0.006)	326.731 (1)	<.001	1.117 (1.099–1.134)
Overall mortality	3.111 (0.330)	88.997 (1)	<.001	22.440 (9.598–52.461)

Note. *CI = confidence interval; GCS = Glasgow Coma Scale; ISS = Injury Severity Score; LOS = length of stay; MAP = mean arterial pressure; OR = odds ratio.*
[a]*Excludes 257 patients with missing ED vital signs; n = 9,476; area under the curve = 91.5%.*

the therapy as a result of trauma. This can also act to capture patients with deteriorations that might have been interrupted with earlier intervention. Furthermore, by using the cutoff of three or more ICU calendar days after ICU admission from the ED, NFTI likely excludes patients who were merely receiving intensive, short-term observation, which could easily span two calendar days. This is because the National Trauma Data Standard (NTDS) defines ICU LOS in integer calendar days that are rounded up (American College of Surgeons Committee on Trauma, 2016). Under this definition, an ICU admission at 11:59 p.m. on a Monday that lasts for 2 min would span two calendar days (1 min on Monday night and until 12:01 a.m. on Tuesday). Optimally, one would measure ICU LOS in at least hours, if not minutes, but one of the main goals of NFTI was to work within the existing system so as to be easily implemented across trauma centers. Thus, although NFTI is slightly more conservative than the suggestions in *Resources for Optimal Care of the Injured Patient* (Rotondo et al., 2014), NFTI likely focuses more on the critical nature of the patient after trauma, which allows it to filter out factors that are potentially related more to complications or other factors, and less to the injuries themselves. However, both NFTI and the 2014 suggestions are reliant on proper treatments.

As noted, one of the main goals of NFTI was to use variables that most, if not all, trauma centers would already record and that are defined by the NTDS—although the NTDS does not differentiate between OR and IR for ED discharge dispositions as of 2017 admissions (American College of Surgeons Committee on Trauma, 2016). However, it is worth noting that NFTI's blood transfusion criterion is required only for centers that are members of TQIP—although there is no reason why nonmembers could not record this field as well. Thus, many trauma centers should be able to implement NFTI as an automatically calculated variable in their registry software or, if not, run it using common spreadsheet software. To aid in adding NFTI to registries, Supplemental Digital Content 1, available at: http://links.lww.com/JTN/A1, contains an Excel spreadsheet with a short questionnaire that generates the code to calculate NFTI in TraumaBase, as well as instructions on adding the code (301 KB). This includes an option for centers that are not members of TQIP to approximate the TQIP transfusion field based on PRBC being given within 1 day of arrival and as one of the first five procedures. This also allows the criterion to be approximated in patients arriving prior to 2013, when the TQIP field was added. Interested centers that use other registry software are encouraged to contact their vendors.

LIMITATIONS

Although the results of this study are encouraging, it does have its limitations. Although the primary limitation of this

TABLE 4 Multivariable Associations With NFTI+ Excluding Mortalities Within 60 hr[a]

	β (SE)	Wald χ^2 (*df*)	*p*	OR (99% CI)
Full-team activation (referent)		215.657 (4)		
Partial-team activation	−0.628 (0.093)	45.762 (1)	<.001	0.533 (0.420–0.678)
Trauma surgery consult	−1.472 (0.101)	214.347 (1)	<.001	0.230 (0.177–0.297)
Subspecialty surgical consult	−0.759 (0.160)	22.391 (1)	<.001	0.468 (0.310–0.708)
Nonsurgical admission	−19.241 (2933.234)	0.000 (1)	.995	4.4E-9 (4.9E-196–4.2E+188)
Age	0.006 (0.002)	9.309 (1)	.002	1.006 (1.001–1.011)
Male gender	0.127 (0.082)	2.404 (1)	.121	1.135 (0.919–1.402)
Penetrating trauma	1.084 (0.100)	117.524 (1)	<.001	2.955 (2.285–3.823)
ISS	0.077 (0.005)	221.736 (1)	<.001	1.080 (1.065–1.094)
Pulse rate	0.007 (0.002)	13.459 (1)	<.001	1.007 (1.002–1.012)
MAP	−0.005 (0.002)	7.244 (1)	.007	0.995 (0.991–0.999)
GCS	−0.385 (0.020)	364.856 (1)	<.001	0.680 (0.646–0.717)
Total LOS	0.112 (0.006)	330.829 (1)	<.001	1.118 (1.101–1.136)
Mortality after 60 hr	2.468 (0.341)	52.398 (1)	<.001	11.805 (4.904–28.414)

Note. CI = confidence interval; GCS = Glasgow Coma Scale; ISS = Injury Severity Score; LOS = length of stay; MAP = mean arterial pressure; OR = odds ratio.

[a]Excludes 252 patients with missing ED vital signs and all mortalities within 60 hr; n = 9,082; area under the curve = 89.7%.

study might appear to be the use of retrospective data, this is not the case given that NFTI is intended for use as a retrospective metric. Accordingly, although measuring resource consumption and outcome may provide a more accurate assessment of trauma patients in later case reviews, this approach precludes the use of NFTI for field or ED triage decisions. However, ISS and others suffer from this same issue by relying on diagnosis codes that are only assigned later. The main weakness of this study is the single-center nature of the data, and NFTI may not be as successful at other institutions—although multi-institutional studies are planned. In addition, NFTI is reliant on the appropriate treatment being provided to the individual patient, as well as both proper documentation of these treatments in the medical record and on these treatments being correctly entered into the registry. As such, if any of these crucial links fails, NFTI can become unreliable. The selected criteria, however, are commonly

TABLE 5 Odds Ratios and AUC Results of Overall Mortality and Mortality After 60 hr for NFTI+ and ISS Greater Than 15

	Statistic	Overall Mortality	Mortality After 60 hr
NFTI+	OR (99% CI)	176.503 (85.396–364.809)	46.702 (22.086–98.756)
	AUC (99% CI)	0.892 (0.879–0.905)	0.862 (0.829–0.896)
	Sensitivity	0.977	0.918
	Specificity	0.807	0.807
ISS >15	OR (99% CI)	29.893 (21.477–41.607)	12.761 (7.955–20.471)
	AUC (99% CI)	0.844 (0.822–0.866)	0.779 (0.726–0.831)
	Sensitivity	0.870	0.741
	Specificity	0.817	0.817

Note. AUC = area under the curve; CI = confidence interval; ISS = Injury Severity Score; NFTI = Need For Trauma Intervention; OR = odds ratio.

recorded by registry staff and are well defined. Thus, they are likely less prone to misinterpretation, unlike the complex subtleties involved with diagnosis coding systems (e.g., International Classification of Diseases, or Abbreviated Injury Scale), which can be inaccurate 16%–80% of the time (Curtis, Bollard, & Dickson, 2002; Ewing et al., 2015; Misset et al., 2008; O'Malley et al., 2005). In spite of its limitations, this study suggests that NFTI has both face and internal validity as an indicator of major trauma.

CONCLUSIONS

As noted in the discussion, NFTI is unlike other clinical metrics. Instead of measuring anatomy or physiology, NFTI measures resource consumption and outcome in the early phases of hospitalization. Purely anatomic scales—especially those based on anatomic diagnoses—can be inaccurate because of physiologic differences and the amount of subjectivity involved in coding. Physiologic scales can be similarly inaccurate due to idiosyncrasies, such as baseline bradycardia in athletes or from β-blockers. Likewise, scales that combine both are likely to suffer the weaknesses of both, not just gain their strengths. In contrast, measuring resource consumption may provide a method to avoid many of these issues. Future research should consider the potential benefits of this approach to measuring disease severity. Indeed, NFTI may even replace or supplement the current Cribari matrix method of measuring over- and undertriage. Before making such a change, however, NFTI needs to be evaluated with multi-institutional data.

It is worth noting that one of the reasons that NFTI appears to work so well is that it does not try to give a better answer to an old question. Thus, despite—or perhaps thanks to—its departure from measuring anatomy and physiology, NFTI appears to be a unique, simple, and valuable tool that can standardize and expedite the case review process and is likely better able to account for factors that can befuddle other metrics (e.g., age, frailty, comorbidities). Therefore, rather than asking the typical question of how severely injured the patient was, NFTI asks a new and perhaps better question: Did the patient actually need a trauma activation? This should allow centers to better identify major trauma. In short, the NFTI metric's simplicity, NTDS-defined variables, and effectiveness combine to make it a truly *nifty* metric.

KEY POINTS

- The preexisting anatomic and physiologic metrics used in trauma are often unreliable due to age, frailty, comorbidities, or a combination thereof. For example, if a healthy 20-year-old and an anticoagulated 60-year-old suffer the same head injury, the 20-year-old is far less likely to need a full trauma team than the older patient.
- The Need For Trauma Intervention (NFTI) metric attempted to avoid these issues by measuring acute-phase resource consumption and mortality. The NFTI criteria are receiving PRBC within 4 hr; discharge from the ED to the OR within 90 min; discharge from the ED to IR; discharge from the ED to the ICU with an ICU LOS of 3 or more days; mechanical ventilation outside of procedural anesthesia within 3 days; or death within 60 hr. Patients meeting any criteria are classified as needing a trauma activation (NFTI+); patients meeting none of these criteria are considered unlikely to have needed a trauma activation.
- Being NFTI+ was associated with higher trauma team response levels, older age, higher ISS, worse ED vitals, longer hospital LOS, and mortality. NFTI outperformed the standard ISS cutoff of greater than 15 for detecting mortality: only 13 of 561 deaths were not NFTI+ and all were in patients with DNR orders; using ISS greater than 15 missed 73 mortalities, 46 with DNRs.
- The NFTI metric appears to be a better indicator of major trauma by avoiding many of the issues that hinder other metrics, and it provides a standardized metric to use during second-level case reviews.

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